Title: A multicentre development and evaluation of a dietetic referral score for nutritional risk in sick infants

Konstantinos Gerasimidis[1]*, Shamsi Milani[1], Andrew Tester[1], Orla Purcell[1], Catriona Woodley[1], Melina Tsiountsioura[1], Alexandra Koulieri[2], Ourania Zerva[2], Konstantina Loizou[2], Mandana Rafeey[3], Meropi Kontogianni[4], Charlotte Wright[1]

[1] School of Medicine, Dentistry and Nursing, College of Medical, Veterinary and Life Sciences, University of Glasgow, New Lister Building, Glasgow Royal Infirmary, G31 2ER. United Kingdom

[2] Department of Nutrition & Dietetics, Athens General Children's Hospital "Pan. & Aglaia Kyriakou", Athens, Greece

[3] Paediatric Child Health Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

[4] Department of Nutrition and Dietetics, School of Health Sciences and Education, Harokopio University, Athens, Greece

Address correspondence to

Dr Konstantinos Gerasimidis

Lecturer in Clinical Nutrition

School of Medicine, Dentistry and Nursing

College of Medical, Veterinary and Life Sciences

University of Glasgow, New Lister Building, Glasgow Royal Infirmary,

G31 2ER. United Kingdom

Email: konstantinos.gerasimidis@glasgow.ac.uk

Tel: 0044 141 201 8689

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Abbreviations: iNEWS: infant nutrition early warning score

Abstract

Background & Aims: Unrecognized nutritional issues may delay recovery in hospitalized infants. It has been proposed that nutritional risk screening should be performed at hospital admission, but few tools include infants. The aim of this study was to develop and test a tool to identify sick infants in need of dietetic input.

Methods: Hospitalised infants were recruited from hospitals in the United Kingdom (UK), Greece and Iran. Weight, skinfold thickness and mid upper arm circumference (MUAC) were measured, with detailed dietetic assessment in the UK and Greece. Simple screening questions were used in the UK cohort to formulate a score (infant early nutrition warning score-iNEWS) which was then validated in the Greek and Iranian groups.

Results: After dietetic assessment, 20 (9.6%) UK and 22 (22%) Greek infants were rated as needing dietetic input. Underweight, poor weight gain/loss and reduced intake were all independent predictors of perceived need for dietetic input in stepwise multivariate regression analysis. The score based on these items (iNEWS), had 84% sensitivity, 91% specificity and 49% positive predictive value to predict need for dietetic input in the UK cohort. In the Greek cohort this was 86%, 78% and 53% respectively. In all three countries, infants with high iNEWS had significantly lower average skinfold thickness (between -1 to -1.8 SD, $p<0.0001$) and MUAC (between -1.8 to -2 SD, $p<0.0001$) than those at low risk.

Conclusions: iNEWS, a simple nutritional risk tool, identifies most hospitalised infants who need dietetic input.

Word count: 2,867

Introduction

It has been argued, that sick children in need of nutritional intervention often remain undetected and untreated in clinical practice [1] and that a process of screening, assessment and treatment of children at nutritional risk should be introduced in routine admission procedures. As dieticians are usually a scarce resource, it has been proposed that nutritional screening tools (NST) should be used by nursing staff or junior paediatricians to identify children needing dietetic input [2].

Several NST have been developed for paediatric inpatients and have been compared in different studies against various benchmarks of nutritional risk [3, 4]. As there is no gold standard measurement of nutritional risk, the comparators used in most studies have either been other NST [5] or anthropometry[6, 7]. This introduces circularity as low weight or BMI often also forms part of the NST. As the real objective of a NST is to identify children who require dietetic input, this should be the appropriate benchmark to use to assess screening validity. Previous studies also rarely addressed the practical utility of NST which need to be quick and simple and should identify cases that would otherwise be missed [8], while not identifying too many false positives.

The highest proportion of sick children at nutritional risk is infants and neonates [9] and their rapid growth means that NST designed for children are unlikely to be valid. Yet there is only one NST which included any infants in its development and none which includes infants aged under one month [4]. Hence, there is clearly a need to develop and test a NST for this early age range.

The aim of this study was to develop and test a tool which will identify infants in need of dietetic input, using data from three different international settings. Our detailed objectives were:

1. Collect data on four clinical predictors of nutritional risk in hospitalised infants in the UK and explore their ability to predict need for dietetic input.
2. Use these predictors to derive a weighted nutritional risk score and define the most effective screening threshold.
3. Assess the screening validity of the nutritional risk score when applied to an independent Greek cohort.
4. Test the score's discriminant validity using skinfold thickness and mid upper arm circumference (MUAC), as independent proxies of nutritional risk in the UK, Greek and Iranian datasets.

Materials and Methods

Recruitment

Convenience samples of inpatients were recruited from a variety of clinical specialties in three tertiary children's hospitals: Glasgow, United Kingdom (UK), Athens, Greece and Tabriz, Iran. Recruitment was carried out from January 5th 2011 to July 28th 2013. Infants were eligible for recruitment if they were less than one year of age, admitted from home and had been an inpatient for less than 48 hours. Patients from the short stay ward, oncology unit, intensive care unit were not included and in Iran all children under four weeks old were excluded, as in that setting many of these children had been admitted directly from other units due to problems at birth. Most eligible admissions were studied, but apparently higher risk infants were prioritised to ensure sufficient numbers of high risk cases.

Measurements of weight and length were collected according to the WHO standard operational procedures and were converted into z-scores using the WHO international data [5, 9]. For infants over 3 months old, the triceps and subscapular skinfolds were converted into z-scores using the WHO standards, which are only available from the age of three months. The average skinfold z-score was then calculated for the two skinfold sites and used in subsequent analysis.

Comprehensive nutritional assessment was performed in the UK by three qualified research dietitians/nutritionists and in Greece by the three hospital paediatric dietitians. The assessment included measurements of weight and length, growth trajectory, dietary intake, clinical and any available laboratory data. The dieticians then recorded whether they judged that dietetic input would be justified or not. This outcome comprised the benchmark for the development and validation study of the iNEWS, as it was considered to have direct clinical relevance for routine practice. Data on patient demographics and disease characteristics were retrieved from the medical notes and via caregiver interview.

Development of the infant nutrition early warning score (iNEWS).

The initial candidate components for the tool were based on the ESPEN recommendations for nutritional screening [10]. The four *'a priori'* selected predictors were:

1. Weight below 9th centile or 2nd centile, indicating the current nutritional status of the infant.
2. Health professional's concern about slow weight gain, as reported by the caregivers, suggesting recent deterioration of nutritional status.
3. Reported decrease in usual dietary intake for more than 5 days, indicating increased likelihood of future deterioration of nutritional status.
4. The impact of the admission condition (as judged by the assessor) on infant's nutritional risk, suggesting increased future risk of deterioration in nutritional status.

At the early development stage each item was reported in Yes/No format, with no scoring assigned to each of these nutritional risk predictors.

Using the UK dataset, these predictors were regressed against the outcome of the comprehensive nutritional assessment (i.e. need for dietetic input), using binary logistic regression analysis. The predictors which were statistically significant ($p<0.05$) in univariate analysis were introduced stepwise in a multivariate model, starting from the predictors which explained the largest variation (i.e. highest coefficient of determination) in the outcome variable. Non-significant predictors were removed from the model until a final model with only significant predictors was concluded.

The β coefficients of each of the significant predictors in the final multivariate model were then used as scores in the final prototype tool. The optimal overall iNEWS screening threshold for referral for dietetic input was defined using Receivers Operating Curve (ROC) analysis.

Cross-validation in a second independent international cohort

The iNEWS score was then cross-validated using the Greek cohort, where hospital dietetic staff performed comprehensive nutritional assessment independently. The sensitivity, specificity and positive and negative predictive values of iNEWS were calculated. Assessment of diagnostic validity was not possible in Iran as hospital dietitians were not available.

Discriminant validity

In all three international cohorts, the discriminant validity of iNEWS was tested using the extent to which iNEWS distinguished between children with high and low body fat stores as well as against MUAC measurements. The proportion of children with both BMI z-score and mean skinfold thickness z-score < 2nd centile was calculated and grouped according to their iNEWS screening outcome.

Statistical analysis was performed with MINITAB version 17 Ltd, UK and MedCalc Statistical Software version 17.6 (MedCalc Software bvba, Ostend, Belgium).

Sample size calculation

Power calculation was performed for the assessment of discriminant validity of iNEWS. Using the Altman nomogram, 70 subjects per group gave 80% power to detect a difference of 0.5 SD in skinfolds between any two groups.

Ethical considerations

The study was conducted in accordance with the guidelines outlined in the Declaration of Helsinki and all procedures involving human subjects were approved by the West of Scotland Research Ethics Committee, Glasgow, the Ethics Committee of the Paediatric Health Research Centre in Tabriz University, Tabriz and the Ethics Committee of the General Children's Hospital "Pan. & Aglaia Kyriakou" in Athens. Infants' parents provided written consent. The study was registered under in www.clinicaltrials.gov (NCT03323957).

Results

Subject characteristics

In total, 499 infants [mean (SD), age; 0.41 (0.28) y, males, n=296 (59%)] were recruited from all centres (Figure 1). Around half of the infants were admitted with medical infectious diseases, with the highest proportion in Iran, while 16-25% were admitted for surgical procedures (Table 1). Infants from Iran were significantly shorter than the other two cohorts and mean weight and BMI z-scores were significantly lower in the Greek and Iranian children than their Scottish counterparts (Table 1). Sixty four (13%), 120 (25%) and 130 (27%) of the infants were classified as short, underweight and thin respectively, with significantly higher proportions observed in the Greek and Iranian groups (Table 1). There were 307 children aged over 3 months with skinfold measurements for whom WHO standards are available. 92 (30%) of these had a mean z-score measurement below -2 SD (2nd centile). A significantly higher proportion of infants with suboptimal fat stores were seen in Iran and Greece than in the UK (Table 1). In the UK and Greece, where comprehensive dietary assessment was performed, 20 (9.6%) and 22 (22%) respectively, were rated as needing dietetic input.

Development of iNEWS

In univariate logistic regression analysis, all four of the putative predictors were predictive of need for dietetic input (validation outcome). In stepwise multivariate analysis, the effect of the current medical condition on nutritional risk was not independently predictive, so it was excluded from the final model (Table 2).

Selection of optimal referral threshold and screening validity

A weighted score was then developed using the β coefficients of the three remaining steps (Table 2). Using ROC analysis, the optimal screening threshold of iNEWS was a total score of greater than 3.9, with 84% sensitivity, 91% specificity, 49% positive predictive value (PPV) and 98% negative predictive value (NPV) in the UK cohort. The screening validity of iNEWS using other screening thresholds is presented in Table 3. Applying this score and threshold to the Greek cohort produced a very similar sensitivity (86%), PPV (53%) and NPV (95%), despite a slightly lower specificity 78% (Table 4). Collectively, 33 (16%) of the UK, 36 (36%) of the Greek and 83 (46%) of the Iranian infants had iNEWS > 3.9 and were thus screened positive. The final iNEWS form is presented in Figure 2 in the format of a) a numerical-based layout and b) a decision-tree based algorithm. A high resolution form and quick reference guide on how to use iNEWS is presented as Online Supplementary Files.

Analysis of misclassified cases

Of the 69 screen positive infants in the Greek and the UK cohorts who also had dietetic assessment, 34 (49%) were rated as not needing dietetic input. There was a trend for infants with false positive screens to have a medical condition associated with increased nutritional risk (63% vs 37%; p=0.102) and a shorter length of hospital stay (4 vs 5 days; p=0.063) than the true positive cases of nutritional risk. Only six of the infants screened as low risk using iNEWS were rated as needing dietetic input. No characteristic distinguished these children from the true positive screens.

Discriminant validity of iNEWS

The skinfold thickness and MUAC z-score of patients classed at high nutritional risk were one to two SD lower than those at low risk in each country (Table 4). Among the infants with low average skinfold measurements (< 2nd centile), 29% (2/7) UK, 54% (14/26) Greek and 80% (47/59) of the Iranian infants had high risk iNEWS. From the 299 children with measurements of both BMI and skinfolds, 66 (22%) had both of these below the 2nd centile indicating children who were both thin and had depleted fat mass stores. In this group, 50% (2/4) in the UK, 84% (38/45) in Iran and 76% (14/17) in Greece screened positive on iNEWS (Figure 3). Infants with high iNEWS scores had a longer mean length of hospital stay than those with low risk screens [iNEWS positive (SD) vs iNEWS negative (SD); 8.8 (8.3) vs 4.6 (3.9) days; $p<0.0001$]. This effect was independent of country (data not displayed). The discriminant validity of iNEWS against the WHO criteria of acute malnutrition is presented in Table 4.

Discussion

Identification of hospitalized infants at high nutritional risk is clearly desirable, but at present there is no consistent approach to this in routine hospital practice [11]. This study has shown that a combination of the weight centile plus two screening questions identifies the majority of children who need dietetic input, while only requiring a minority of infants to be further assessed. Of the four elements studied, anthropometry was the strongest predictor, followed by a history of poor weight gain/loss, while reduced dietary intake was the least predictive.

The predictive effect of the child's admission condition, which has been used in previous scores [4, 12], proved not to be independently associated with the need of dietetic input. Other NST use lists of diagnoses, but such lists can never be exhaustive and the nutritional risk of patients with chronic illness can vary markedly during the course of their disease [13]. The iNEWS therefore aimed to evaluate how the disease condition, at the point of hospital admission, was likely to affect the infant's intake, requirements and losses. Although in univariate analysis the patient's admission condition was predictive of valid dietetic input, in multivariate analysis this effect lost statistical significance, suggesting that most of this effect was explained by the other iNEWS components, including changes in dietary intake and weight loss. By applying the current modelling methodology we were thus able to remove a degree of predictor redundancy and simplify the tool further.

The binary nature of each iNEWS component offers a limited range of possible alternative cut-offs and the optimal screening threshold was chosen with the aim of optimising both sensitivity and specificity. Using the iNEWS cut-off of 3.9, defines all infants below the WHO 2nd weight centile as high risk, as well as infants with slow weight gain/loss who are below the 9th centile, or an infant of any weight with both slow weight gain and reduced intake (Figure 2).

Very few children rated as needing dietetic input were missed by iNEWS screening and no characteristic distinguished these cases from those correctly identified. In contrast, the false positive screens were slightly more likely to suffer from a condition associated with high nutritional risk. Although this was of only borderline statistical significance, this further suggests that the underlying condition is not always usefully informative about nutritional risk. These infants may have experienced a recent decrease in dietary intake and transient weight loss, but were on the whole not at long-term nutritional risk. Although roughly half of the children who screened positive proved not to be at real nutritional risk, this is an acceptable false positive rate, which in a UK or Greek context would not represent unmanageable referral rates.

The study aimed to oversample for high risk patients and thus did not recruit a fully representative population, which in developed countries would mainly comprise low risk cases [5]. In the Iranian sample nearly half the infants studied screened positive, but their skinfold and MUAC results suggest that rates of actual malnutrition were truly high. Use of iNEWS in this country could be expected to halve the number of children needing to be referred for dietetic assessment.

If avoidance of false positive referrals was the priority, a higher cut-off of 4.2 could be used instead, which would include infants with weight below 2nd centile if they also had either slow weight gain or reduced intake, or infants below 9th with both slow weight gain and reduced intake. This would mean that only 16 (8%), 67 (37%), and 26 (26%) in the UK, Iran and Greece respectively, would be referred for further assessment; 75% of whom would be true cases requiring dietetic input. However, this increase in positive predictive value would be at cost of missing over a third of all children needing dietetic input (Table 3).

Previous studies have assessed the performance of nutritional screening tools against the WHO criteria of acute and chronic malnutrition [7, 14]. However, the objective of a NST is not just to identify sick children who are already malnourished, but also those likely to become so in future, and it is these latter children who will make up the majority of cases referred for dietetic input in most developed countries. Our benchmark does not represent an absolute state of nutritional status, but instead reflects the characteristics of the children that dietitians recognise as needing dietetic input. Only one other published screening tool has also included infants, the STRONGkids tool, and we also tested its performance in the current study. Compared with our benchmark of comprehensive dietetic assessment, STRONGkids had a good positive predictive validity (63%) but lower sensitivity (41%) than iNEWS. From the 66 children who had both measurements of BMI and skinfolds below the 2nd centile, 20 (30%) scored at high risk of malnutrition using STRONGkids, 43 (65%) scored moderate and three (5%) rated as low risk. We made a similar observation in our European multicenter study which compared all three popular screening tools [5] and this is possibly because health professionals were required only to estimate body size by observation [15].

Most NST have been tested against weight-for-height or BMI, but this may be misleading in chronically sick infants who commonly have low lean mass. Thus we explored fat stores as an independent index of acute malnutrition. A limitation of this is the lack of WHO reference data for skinfolds for infants aged under three months, which reduced the available sample size. However high scoring infants, aged over 3 months, had much lower levels of fatness and were more likely to have subnormal fat levels than their low scoring counterparts. These differences were more striking in Greece and Iran. Some children with low measurements of skinfolds did not have high iNEWS. These could be infants for whom no ongoing nutritional concerns existed, despite low fatness levels, or infants whose low fatness was masked by higher lean mass levels.

The main strengths of this study are the large sample size of infants in three different countries, the objective statistical approach used to construct the iNEWS and decide its threshold, the use of independent international cohorts for validation and the use of other independent measures of nutritional risk to assess discriminant validity. A limitation is the lack of comprehensive dietary assessment in the Iranian group. However, the equal performance of iNEWS against skinfold measurements suggests that iNEWS would still work well in this setting. iNEWS did not account for prematurity in assessing the weight centile element, as this would have made the weight centile table and form (Figure 2) too complex for nursing or junior medical staff to use. This may make ex-preterm infants more likely to screen positive, but as this is a group at increased nutrition risk, this may be an advantage rather than a limitation [16]. The use of convenience sampling, different referral patterns to the different centres and the exclusion of children less than one month of age in Iran, makes it almost certain that the type and severity of illness was different between the centres, as well as the likely varying background risk of community malnutrition in these countries. This can be considered a strength of the study though, as it tests the usefulness of the tool in a range of health settings, but this means that these data cannot provide an estimate of the true prevalence of undernutrition in hospitalised children in each country.

In conclusion, iNEWS appears to be an easy and valid tool to identify hospitalised infants who need further dietetic input. Future research should evaluate its performance in routine clinical practice and whether such screening improves overall clinical outcomes.

Statement of authorship

KG and CMW conceived and designed the study, KG, CMW, MR, MK co-ordinated and supervised research activities in each centre; SM, AT, OP, CW, MT, AK, OZ, and KL conducted the research; KG and SM performed statistical analysis; KG produced the first draft manuscript; CMW and MK edited the first manuscript; all authors approved the final submitted manuscript.

Conflicts of interest statement: KG received research grants, speakers fees and had conference attendance paid from Nestle, Mead Johnson, Nutricia and Dr Falk. The rest of the authors have no conflicts of interests to disclose.

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Figure Legends

Figure 1: Participants flowchart

Figure 2: The infant nutrition early warning score

Panel A) numerical-based layout, Panel B) a decision-tree based algorithm

Figure 3: Concordance analysis between BMI Z-score and the mean of triceps and subscapular Z-score

Table Legends

Table 1: Descriptive characteristics of the subjects in the three cohorts of the study

Table 2: Multivariate model including only significant predictors of outcome[a].

Table 3: Screening performance of iNEWs using alternative thresholds

Table 4: iNEWS screening performance compared with comprehensive dietetic assessment and other anthropometric indices of nutritional risk.

Table 1: Descriptive characteristics of the subjects in the three cohorts of the study

	UK, N=210	**Greece, N=102**	**Iran, N=187**
% (N)			
Reason of admission			
Medical infectious	53% (111)	39% (40)	70% (131)
Other medical	23% (48)	36% (37)	14% (26)
Surgical	24% (51)	25% (25)	16% (30)
Median, IQR			
Age, years	0.32 (0.14 : 0.59)	0.40 (0.25 : 0.62)	0.33, (0.14 : 0.56)
Weight Z-score	-0.22 (-1.03 : 0.39)	-0.93 (-2.33 : -0.12)	-1.45 (-2.42 : -0.40)
Height Z-score	0.05 (-0.74 : 0.89)	0.23 (-1.13 : 1.25)	-0.41 (-1.70 : 0.54)
BMI Z-score	-0.30 (-1.22 : 0.34)	-1.60 (-2.52 : -0.75)	-1.52 (-2.54 : -0.71)
Average skinfolds Z-score	0.20 (-0.68 : 0.91)	-1.54 (-2.59 : -0.26)	-1.83 (-2.99 : -0.93)
MUAC Z-score	0.07 (-1.03 : 1.15)	-1.72 (-2.68 : -0.50)	-1.50 (-2.33 : -0.48)
% (N)			
Weight < 2nd centile	12% (24)	32% (32)	35% (64)
Weight < 9th centile	19% (39)	41% (41)	51% (94)
Height < 2th centile	8% (15)	15% (15)	19% (34)
BMI < 2th centile	12% (23)	36% (36)	39% (71)
Mean skinfolds < 9th centile	12% (14)	58% (35)	65% (87)
Mean skinfolds < 2th centile	6% (7)	43% (26)	44% (59)
MUAC < 11.5 cm	24% (50)	48% (47)	38% (70)

BMI: Body mass index; IQR: interquartile range; MUAC: Mid upper arm circumference; UK: United Kingdom

Table 2: Multivariate model including only significant predictors of outcome[a].

Predictors	**β coefficient**	**Odd ratio (95% CI)**	**p-value**
Weight			P<0.0001
2nd centile	-3.99	0.019 (0.004, 0.087)	
9th centile	-2.05	0.128 (0.016, 1.045)	
Poor weight gain/loss (yes)	-2.18	0.113 (0.028, 0.457)	P=0.002
Decrease in usual intake (yes)	-1.75	0.174 (0.042, 0.723)	P=0.012

[a]i.e. valid request for dietetic input; CI: confidence intervals

Table 3: Screening performance of iNEWs using alternative thresholds

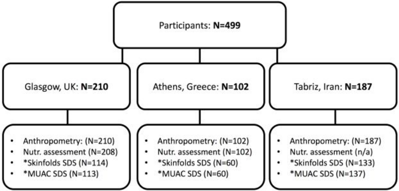
iNEWS threshold	Sensitivity (%)	95% CI	Specificity (%)	95% CI	PPV (%)	NPV (%)
1.7	94.7	74.0 - 99.9	56.8	49.3 - 64.1	18.8	99.0
2.0	89.5	66.9 - 98.7	78.1	71.4 - 83.9	30.3	98.6
2.2	89.5	66.9 - 98.7	84.1	78.0 - 89.1	37.4	98.9
3.8	84.2	60.4 - 96.6	90.2	84.9 - 94.1	47.7	98.2
3.9	**84.2**	**60.4 - 96.6**	**90.7**	**85.5 - 94.5**	**49.0**	**98.2**
4.0	78.9	54.4 - 93.9	93.4	88.8 - 96.6	55.9	97.7
4.2	63.2	38.4 - 83.7	97.8	94.5 - 99.4	75.3	96.2
5.7	57.9	33.5 - 79.7	98.4	95.3 - 99.7	79.3	95.6
5.9	42.1	20.3 - 66.5	98.9	96.1 - 99.9	80.2	94.1

CI: Confidence interval; NPV: Negative predictive value; PPV: Positive predictive value; Optimal cut-off is denoted with bold fonts

Table 4: iNEWS screening performance compared with comprehensive dietetic assessment and other anthropometric indices of nutritional risk.

	UK	Greece	Iran
Diagnostic values of iNEWS			
Sensitivity	84%	86%	NA
Specificity	91%	78%	NA
Positive predictive value	49%	53%	NA
Negative predictive value	98%	95%	NA
Median, IQR			
[a]Average skinfold z-score			
High iNEWS	-0.81 (-1.83 : 0.24)	-2.60 (-3.10 : -1.21)	-2.81 (-3.53 : -1.96)
Low iNEWS	0.27 (-0.50 : 1.15)	-1.29 (-2.10 : -0.02)	-1.05 (-1.72 : -0.39)
p-value	0.004	0.001	<0.001
[a]Median MUAC z-score			
High iNEWS	-1.73 (-2.63 : -1.11)	-2.54 (-3.63 : -1.89)	-2.29 (-3.38 : -1.64)
Low iNEWS	0.31 (-0.52 : 1.24)	-0.62 (-2.17 : 0.15)	-0.54 (-1.34 : 0.06)
p-value	<0.001	<0.001	<0.001
% (N)			
High iNEWS score	16% (33)	36% (36)	46% (83)
Average skinfold < 2nd centile	6% (7)	43% (26)	45% (59)
High iNEWS	29% (2)	54% (14)	80% (47)
BMI < 2nd centile	12% (23)	36% (36)	39% (70)
High iNEWS	18% (78)	72% (26)	84% (59)

[a] for children > 3 months for whom WHO standards exist; BMI: Body mass index; MUAC: Mid upper arm circumference; NA: non-applicable



* N of patients with measurements and for whom WHO standards for calculation of Z-scores (SDS) were available

n/a: nutritional assessment was not available in Iran

University of Glasgow

iNEWS

infant nutrition early warning score

NHS Greater Glasgow and Clyde

Name:	Sex:	
DoB:	Weight (to nearest 10g) :	Ward:______
Date of screening:	Hospital number:	

		Score
STEP 1: Is a health professional concerned about your child's weight gain?	YES	2.2
STEP 2: Has your child had a reduced intake (including feeds) for at least the past 5 days?	YES	1.7
STEP 3: Is the weight of the infant below column A or column B in the weight lookup table below?	YES, below column A	4
	YES, below column B	2

	Weight lookup table for STEP 3			
	Columns for Males		Columns for Females	
Age of infant in months	A	B	A	B
0	2.460	2.730	2.390	2.660
1	3.390	3.730	3.160	3.480
2	4.320	4.710	3.940	4.310
3	5.020	5.440	4.540	4.940
4	5.560	6.010	5.010	5.440
5	6.000	6.470	5.400	5.860
6	6.350	6.850	5.730	6.210
7	6.650	7.170	6.000	6.510
8	6.910	7.440	6.250	6.770
9	7.140	7.690	6.470	7.000
10	7.360	7.920	6.670	7.220
11	7.550	8.130	6.860	7.420

STEP 4: Add together the scores from STEPS 1, 2 and 3 and record the total score	Total iNEWS Score: ________

Refer patient for further assessment if total iNEWS score is equal to or greater than 3.9

A)

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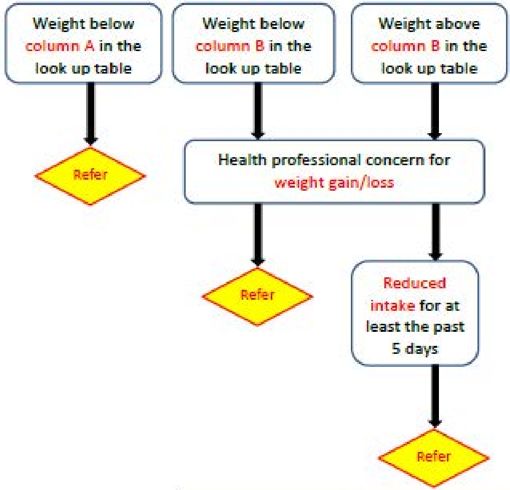
iNEWS

infant nutrition early warning score

NHS Greater Glasgow and Clyde



	Weight lookup table			
	Columns for Males		Columns for Females	
Age of infant in months	A	B	A	B
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1	3.390	3.730	3.160	3.480
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10	7.360	7.920	6.670	7.220
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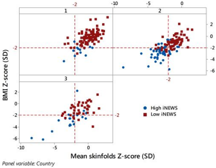
B)



1
2
3
-2
-10
-5
0
2
0
-2
-4
-6
BMI Z-score (SD)
Mean skinfolds Z-score (SD)
High iNEWS
Low iNEWS
Panel variable: Country